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"SUBMERGED SURFACE CLEANER"

BACKGROUND TO THE INVENTION

THIS invention relates to a submerged surface cleaner.

The invention relates in particular to a suction-type submerged surface cleaner, typically for use in cleaning the submerged surfaces of a swimming pool. Suction-type cleaners are well known and have been in widespread use for a number of years.

The most popular suction-type pool cleaners are connected by a flexible hose to a suction point, typically a suction inlet at the weir of the swimming pool. The cleaner operates on the submerged surface and water is sucked through it by the pump of the swimming pool filtration unit. One particularly popular pool cleaner has a valve chamber with an inlet, adjacent the submerged surface, through which a water flow is sucked and accommodating a valve member or hammer which oscillates under the influence of the suction flow and which directs the flow alternately to one or the other of a pair of outlet passages leading away from the valve chamber to the hose. The resulting variations in momentum of the water flow as well as variations in the suction effect at the inlet cause the cleaner to move, preferably in a random manner, over the submerged surfaces of the pool.

It is common for the body of a cleaner of the type described above to be of injection moulded construction and to incorporate one or more external floats as well as an external weight to provide the cleaner with the buoyancy and ballast required to maintain it at an appropriate attitude when submerged in the pool. For instance, It has also been suggested, in WO 00/40826, to mould the plastic structure of the cleaner around a flotation component on an upper side of the body of the cleaner and a weight on a lower side of the body of the cleaner.

It is believed that the use of external floats or a float encapsulated in the moulded plastic material of the cleaner adds unnecessarily to the complexity and cost of manufacture of the cleaner.

SUMMARY OF THE INVENTION

According to the invention there is provided a suction-type submerged surface cleaner comprising:

- an injection moulded cleaner head defining an internal valve chamber formed by valve chamber walls;
- an inlet to the valve chamber;
- an outlet from the valve chamber; and
- a hammer arranged to oscillate in the valve chamber, under the influence of suction flow through the valve chamber from the inlet to the outlet, between respective positions in which opposite faces of the hammer alternately contact internal surfaces of opposing valve chamber walls, thereby to control the flow of liquid through the cleaner head,

wherein contact surfaces of the valve chamber walls, which are contacted internally by the said faces of the hammer, are provided internally by regions of the valve chamber walls which are reduced locally in thickness compared to other regions of the valve chamber walls and wherein at least some relatively thick regions of the valve chamber walls are formed during moulding with internal cavities to provide buoyancy for the cleaner.

Conveniently the cleaner head is injection moulded using a blowing agent which creates the cavities in relatively thick regions of the valve chamber walls.

The preferred cleaner includes a tubular structure moulded separately from the cleaner head and including outlet passages which extend from the valve chamber outlet in side by side relationship. The tubular structure is connected in sealed manner, eg by press-fitting, to the cleaner head. Typically the passages are separated from one another by a dividing wall forming an integral part of the tubular structure, and a lower end of the dividing wall is received in a clevis provided by a retaining member of the cleaner head. The tubular structure may include an external fin formed during moulding with cavities therein to provide buoyancy.

The preferred cleaner also includes an elongate, bowed bump strip having an operatively upper end engagable selectively with any one of a series of retaining formations on the exterior of the tubular structure and an operatively lower end engaged between the ballast weight and the cleaner head. There may in addition be a bumper having a curved rim and a central hub which is attached to the tubular structure so that the curved rim is spaced from the tubular structure.

The regions of the valve chamber wall which are reduced in thickness are typically so reduced by virtue of localised indentations in the external surfaces of the opposing valve chamber walls.

Other features of the invention are set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings.

In the drawings:

Figure 1 shows an exploded perspective view of a submerged surface cleaner according to this invention;

Figure 2 shows a side view of the assembled cleaner with certain components omitted;

Figure 3 shows a bottom perspective view of the cleaner as illustrated in Figure 2;

Figure 4 shows a longitudinal cross-section through the cleaner;

Figure 5 shows a sectioned perspective view of the cleaner head; and

Figure 6 shows a transverse cross-sectional view of the tubular structure of the cleaner at the line 6-6 in Figure 5.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

The drawings show a suction-type submerged surface cleaner 10 according to the invention.

The cleaner 10 includes a cleaner head 12 which defines a valve chamber 14 accomodating a wedge-shaped valve member or hammer 16. The cleaner head terminates at its operatively lower end in a circular foot 18 to which an annular polyurethane footpad 20 is fitted in use, with the inner extremity of a flexible polyurethane skirt 22 sandwiched between the foot and the footpad.

The foot 18 defines a generally rectangular entrance opening 24. Referring to Figure 4, the entrance opening 24 leads to an entrance space 26 having slot-shaped openings 28 on opposite sides and leading to the valve chamber 14. An inlet to the valve chamber is provided by a central opening

30 in a cover 32 which spans across the operatively upper end of the entrance space.

The cover 32 is a separately moulded component with integral projections 34 which are clipped into holes 36 formed in the cleaner head. It will be noted that the cover is generally rectangular and is outwardly convex relative to the valve chamber. The importance of this is described below.

The hammer 16 is wedge-shaped and, although capable of oscillating, is located loosely in the valve chamber. The hammer has an apex 38 and opposite wedge surfaces 40 terminating at edges 42 remote from the apex. Typically the hammer is of moulded polyurethane.

Figure 5 shows a sectional perspective view showing a half of the cleaner head and, in exploded relationship thereto, the cover 30, the hammer 16 and a retainer 44. During manufacture, the retainer 44 is placed in the mould used for the cleaner head and is moulded into the cleaner head, in the position seen in Figure 4, adjacent an outlet 45 from the valve chamber.

The valve chamber is defined by valve chamber walls including a bottom wall 46, an opposite top wall 48 (visible in Figure 4 but not shown in Figure 5) and side walls 50. The hammer 16 can oscillate in a zone 52 defined between steps 53 on the top and bottom walls. During such oscillations, the edges 42 of the hammer 16 make contact alternately with internal surfaces 54 of the opposing top and bottom valve chamber walls 46 and 48. The internal surfaces 54 are provided in regions 56 of the walls 46 and 48 which are reduced in thickness compared to the walls in other regions of the valve chamber. The importance of this is described later. It will be noted that reduced thickness in the regions 56 is attributable to external indentations 58 in the walls 46 and 48.

The retainer 44 has a lower clevis 58 which loosely receives the apex of the hammer 16 and an upper clevis 60.

The cleaner 10 also includes passages 62 and 64 provided side-by-side in a tubular structure 66 of injection moulded construction. As shown in Figure 6, the structure 66 has a central hollow which is sub-divided, by an integral dividing wall 68, to form the respective passages 62 and 64.

A reduced diameter upstream or lower end of the tubular structure 66 is received in a sealed telescopic fit by the upper or outlet end of the cleaner head. At the same time, the lower end of the dividing wall 68 is received in a sealed manner in the upper clevis 60.

The outlet 45 from the valve chamber is circular in cross-section and, with the tubular structure 66 connected to the cleaner head as just described, communicates directly with the passages 62 and 64. At the upstream or lower end, the hollow of the tubular structure which defines the passages 62 and 64 has a circular cross-section corresponding to that of the valve chamber outlet. Proceeding upwardly, in the downstream direction, the circular cross-section converts to a polygonal cross-section as will be apparent from Figure 6. Externally, the tubular structure 66 has a circular cross-section as illustrated. To facilitate demoulding of the tubular structure, i.e. extraction of the necessary core, the structure tapers in overall cross-section, from the lower or upstream end to the upper or downstream end.

The cleaner 10 also includes a bump strip 70 and a ballast weight 72. The ballast weight 72 consists of an appropriate lead mass encapsulated in a moulded plastic cover and is secured to the cleaner head, beneath the valve chamber, by screws 73. The bump strip 70 consists of a length of suitably stiff plastics material which has respective formations 74 and 76 at its upper and lower ends. During assembly of the cleaner, the lower formation 76 is trapped between the ballast weight 72 and the cleaner head and is retained permanently in position by the screws 73. The upper formation is fork shaped and is engagable selectively with any chosen one of a series of tooth-like formations 78 on the lower side of the tubular structure 66, near to its upper end. When so engaged, the bump strip assumes a bowed configuration as seen in Figure 2. As also seen in Figure

2, the extent of the bowing of the bump strip can be varied by varying the upper engagement point. Those skilled in the art will understand that the bump strip is provided to deflect the cleaner, as it moves about the submerged surfaces of a swimming pool, from obstacles such as steps or the like, and thereby ensure that the cleaner is not immobilised by such obstacles.

Extending along the upper surface of the outlet end of the cleaner head is an upwardly extending fin 80. A corresponding fin 82 extends longitudinally along the upper side of the tubular structure 66. These fins cooperate with one another, thereby forming a continuous fin as seen in Figure 2, when the tubular structure is mated with the tubular structure as described above.

Those skilled in the art will understand the mode of operation of submerged surface cleaners of the general type described above. In use a flexible hose extending from a suction point, such as the suction inlet in a swimming pool weir is connected to the upper end of the tubular structure 66 via swivel components 84 seen in Figure 1, which allow the cleaner to swivel freely relative to the hose. Suction applied to the cleaner causes water to be drawn through the entrance opening 24 and side openings 28 into the entrance space 26. The water carries with it submerged muck. In addition, leaves and other submerged debris lifted by the skirt 22 are able to enter the entrance space through the side openings 28.

From the entrance opening, water and entrained muck and debris are drawn into the valve chamber through the inlet opening 30 in the cover 32. The suction draws the hammer 16 into the clevis 58. With the hammer 16 at, say, a lower position, with its lower edge 42 contacting the internal surface 54 of the bottom wall 46, access to the lower passage 64 is blocked. The water is therefore obliged to flow over the hammer, through the valve chamber outlet and into the upper passage 62 and from there into the flexible hose. The flow generates a low pressure over the hammer which causes it to pivot upwardly about its apex. The upper edge 42 of the hammer then contacts the surface 54 of the upper wall 48, blocking off

access to the upper passage 62. The low pressure beneath the hammer now draws it down again, and the process repeats itself, i.e. the hammer oscillates up and down with its edges 42 alternately making contact with the upper and lower valve chamber walls. Flow into each passage must overcome the inertia of the column of water in that passage from the previous cycle. The rapid changes in momentum of the water columns, combined with varying suction effects at the entrance opening 24 cause the cleaner to move randomly over the submerged surfaces.

For proper operation it is important that the cleaner be at the correct attitude in the water. For this reason, the cleaner head and tubular structure 66 are moulded using a blowing agent which creates a structure containing numerous internal voids, bubbles or cavities which increase the buoyancy of the head and tubular structure. The ballast weight 72 acts in cooperation with the buoyancy created by the internal cavities to ensure that the cleaner operates at the appropriate attitude.

It will be understood that the required buoyancy can only be created in walls of the cleaner which are of sufficient thickness. For this reason, the majority of each wall forming the valve chamber has a substantial thickness, in some cases 8mm or more. However a problem which is encountered in the injection moulding of plastic walls of such thickness is that differential cooling on demoulding can lead to irregularities in the molded surfaces.

It is recognized that it is important for the internal surfaces 54 of the walls 46 and 48 to be sufficiently accurate and free of irregularities for the edges 42 of the hammer 16 to make sealing contact as the hammer oscillates. Experience has shown that if there are imperfections which could lead to poor sealing of the hammer at each end of its stroke, the cleaner 10 will not operate efficiently. It is for this reason that the wall thickness in the regions 56 is reduced to a value at which sufficiently accurate surfaces 54 can be obtained for proper sealing on each stroke of the hammer.

Buoyancy created in the manner described above in the relatively thick fins 80 and 82 contributes to maintaining the cleaner at the correct operative attitude.

As indicated above, the cover 32 is outwardly convex with respect to the valve chamber. Thus the inlet opening 30 is spaced some distance from the hammer. With this feature, the chance of leaves or other sunken debris getting jammed between hammer and the inlet opening, and thereby arresting the hammer and bringing the cleaner to a standstill, is reduced.

Figures 7 to 10 illustrate a second embodiment of the invention which exhibits a number of differences to the first embodiment described above. These differences are described below.

With reference to the cleaner head 12 one difference is the formation of integral, laterally projecting shrouds 100 over the slots 28 which serve to guide debris more accurately into those slots. Another difference is the fact that the retainer 44, which in this case is moulded integrally with the remainder of the cleaner head, does not have a lower clevis corresponding to the clevis 58. Instead, the apex 38 of the hammer 16 merely bears against a flat lower surface 102 of the retainer 44. The retainer 44 does however still include the upper clevis 60 in which a planar lower edge 68.1 of the dividing wall 68 of the tubular structure 66 is received.

In the embodiment of Figures 7 to 10, the hammer 16 is composed of upper and lower walls 16.1 and transverse walls 16.2 defining a hollow structure as illustrated.

The passages 62 and 64 of the tubular structure 66 are oval or elliptical in cross-section, and that the dividing wall 68 terminates some distance short of the upper or downstream end of the tubular structure. The elliptical shape of the passages has been found during experimentation to provide advantageous flow characteristics through the tubular structure.

The upper or downstream end 66.1 of the tubular structure 66 is externally threaded in this embodiment. An internally threaded collar 84.1 of the swivel arrangement 84 can be threaded onto that end to maintain a spigot 84.2 in a freely rotatable relationship with the tubular structure. In use, the lower end of a flexible hose can be fitted onto the upper end of the spigot 84.2.

As in the first embodiment the cleaner of Figures 7 to 10 includes a bump strip 70 attached in the manner described previously. However in addition this embodiment includes a generally semi-circular bumper 104. The sides of the tubular structure 66 are formed with elongate recesses 106 across which ribs 108 span at intervals. The bumper 104 has an outer rim 110 joined to a central hub 112 by spokes 114. The central hub is itself generally C-shaped with opposing clip formations 116 at the ends of the arms defining the C-shape. With this configuration, the hub can be clipped to the tubular structure 66 with the clip formations locating in the recesses 106. The ribs 108 prevent longitudinal sliding movement of the bumper relative to the tubular structure. It will be understood that the bumper can be attached in this way to the tubular structure at any selected position along the length of the recesses 106.

The embodiment of Figures 7 to 10 also includes further ribs 118 alongside the fins 80 and 82.

In both embodiments, the lower or upstream end of the tubular structure is a tight press-fit in the upper end of the cleaner head. Typically, the necessary press-fitting operation will be performed in the factory.